

## ADVANTAGES AND DISADVANTAGES OF USING A ROM

Yakymenko V., *group Esm-21*,  
Pochatko T. V. – *E L Adviser*

Before programmable logic devices (PLD) were invented, read-only memory (ROM) chips had been used to create arbitrary combinational logic functions of a number of inputs. Consider a ROM with  $m$  inputs (the address lines) and  $n$  outputs (the data lines). When used as a memory, the ROM contains  $2^m$  words of  $n$  bits each.

The inputs are driven not by an  $m$ -bit address, but by  $m$  independent logic signals. Theoretically, there are  $2^m$  possible Boolean functions of these  $m$  input signals. By Boolean function in this context is meant a single function that maps each of the  $2^m$  possible combinations of the  $m$  Boolean inputs to a single Boolean output. There are  $2^m$  possible distinct ways to map each of  $2^m$  inputs to a Boolean value, which explains why there are  $2^m$  such Boolean functions of  $m$  inputs.

Now, consider that each of the  $n$  output pins acts, independently, as a logic device that is specially selected to sample just one of the possible  $2^m$  such functions. At any given time, only one of the  $2^m$  possible input values can be present on the ROM, but over time, as the input values span their full possible domain, each output pin will map out its particular function of the  $2^m$  possible input values, from among the  $2^m$  possible such functions. Note that the structure of the ROM allows just  $n$  of the  $2^m$  possible such Boolean functions to be produced at the output pins. The ROM therefore becomes equivalent to  $n$  separate logic circuits, each of which generates a chosen function of the  $m$  inputs.

The advantage of using a ROM in this way is that any conceivable function of all possible combinations of the  $m$  inputs can be made to appear at any of the  $n$  outputs, making this the most general-purpose combinational logic device available for  $m$  input pins and  $n$  output pins.

Also, PROMs (programmable ROMs), EPROMs (ultraviolet-erasable PROMs) and EEPROMs (electrically erasable PROMs) are available that can be programmed using a standard PROM programmer without requiring specialized hardware or software. However, there are several disadvantages: they are usually much slower than dedicated logic circuits, consume more power, often more expensive than programmable logic, especially if high speed is required.

Since most ROMs do not have input or output registers, they cannot be used stand-alone for sequential logic. An external TTL (transistor-transistor logic) register was often used for sequential designs such as state machines. Common EPROMs are still sometimes used in this way by hobby circuit designers, who often have some lying around. This use is sometimes called a 'poor man's PAL'.

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